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by Barbara Honegger, Senior Military Affairs Journalist

Advances in applications of atmospheric modeling and prediction by Naval Postgraduate School (NPS) faculty-student teams may make the difference between success and failure for submarine-launched covert operations in the Global War on Terrorism (GWOT).

Over the past two years, NPS Prof. Kenneth Davidson and a team of dedicated students have developed dynamic meteorology and oceanography (METOC) decision aides tailored to GWOT applications. Most importantly, they have honed ways to detect and avoid or exploit critical atmospheric phenomena which can seriously impact radio, infrared and optical signals used by submarines and sub-launched SEAL teams for surveillance, imaging, target designation and route planning. One of the most important of these is a wave guide that traps radio waves called *ducting*.

"Accurate, near-real-time data on the presence and variation of ducting is key to denied-area littoral mission planning and execution because, depending on how high it is above the sea surface, the enemy can see you further from shore, or closer to it, than you think you can be seen," Davidson explained. "Submarine commanders want to launch covert ops teams as close to shore as possible while maintaining stealth, so ducting is key to determining the optimal stand-off distance. Atmospheric variables can also be exploited to optimize the propagation of sub and SEAL delivery vehicle communications signals and surveillance frequencies, so it's vital to both seeing and not being seen."

The development and testing of METOC modeling and prediction applications for submarines and sub-launched covert operations is a new and rapidly developing specialty.

"Two years ago, Submarine Development Squadron 12 (DEVRON 12) came to NPS and asked us to develop capabilities to transition operational METOC products for the Global War on Terrorism, because we've been the group that's supported Navy infrared and radar propagation field testing for the last 15 years," Davidson noted.
"Historically, submarines haven't been concerned with above-the-waterline conditions, but all that changed with the Global War on Terrorism, the conversion of Tridents into special operations subs, and the emphasis on planning for denied-area littoral operations with more SEALs in surface boats," he added. "When teams use a sub for launching missions, you need to ensure correct counter-detection procedures, so your periscope and the delivery vehicles remain unseen."

This year and into 2007, the Navy is reconfiguring four Trident submarines to house as many as 66

special operations troops each. Vertical missile tubes are being converted into lock-in/lock-out chambers allowing SEALs to exit and re-enter the sub while submerged. These and other new capabilities will allow covert operations closer to hostile shores in support of GWOT missions. Though subs have hosted small numbers of special troops since World War II, large number of missiles and torpedoes previously limited the space available for such operations.

"SEALs have become far more METOC aware in the last three to four years," said SEAL and former NPS defense analysis and information systems and operations student Lt. Brian Harp, who developed and field tested essential components of the NPS Atmospheric Detection and Effects Prediction Tool (ADEPT) for his master's thesis under Davidson. Harp is now interagency coordinator for Commander, Second Fleet.

"ADEPT and other enhanced atmospheric-awareness decision tools being developed at NPS are vital to our being able to detect the occurrence of ducting, which can extend above 200 feet depending on air humidity and sea-surface temperature, and can significantly effect the propagation of EM (electromagnetic) signals," Harp noted.

"If the duct is shallow, only radar frequencies are trapped, but if it's deep, communications frequencies are trapped. In field tests, we've been able to measure the thickness of the duct with instruments called radiosondes attached to kites and weather balloons (see photo). We need to explore and test alternative ways to get this information to submarines, as, obviously, they're not able to obtain it by this means."

Harp's thesis, "Small Unit Situational Awareness for Naval Special Warfare," focused on connectivity with tactical-operations centers and Fleet Numerical Meteorological and Oceanographic Center, also in Monterey.

Current NPS information systems and operations student Lt. Angel Rodriquez, a nuclear-qualified submariner, consulted DEVRON 12 before zeroing in on a thesis topic of current operational value.

"My thesis research deals with the submarine itself and its use of atmospheric prediction tools to minimize the probability of detection while maximizing operational efficiency during information operations missions," he said. "It will answer the question, 'What's the best METOC information package a submarine can have to optimize its ability to take advantage of atmospheric conditions?' There's no reason to put a $2 billion-dollar sub in harm's way when you can position it just far enough off shore to preserve the use of ducting effects and optimize the distance to target radars."

"My thesis research with Professor Davidson, who is a phenomenal instructor, definitely prepared me for looking at EM (electromagnetic) propagation through the atmosphere and how near-surface boundary layer meteorology affects it," said recent NPS meteorology and physical oceanography graduate Lt. Cmdr. Richard Murphy. "As METOC officer now for the USS John F. Kennedy, I've seen and used it a lot, and am teaching my Aerographer's Mates what's going on when they use these atmospheric prediction programs."

Lt. Thomas Moneymaker, also a recent meteorology and physical oceanography graduate who is now METOC officer for Commander, Carrier Strike Group Ten, did his thesis on how radars searching for low-cross-section surface targets, like small combatant boats, are affected by the environment.

"This is very manpower intensive right now and needs to become more automated," he said. "I look forward to the time when ducting data goes directly into the radar to adjust it. There's always the threat of missing small boats, and we need to be able to find them faster."

Davidson, NPS Department of Meteorology research staff, and a number of master's students, including Harp and Murphy have demonstrated prototypes of ADEPT and other dynamic METOC decision aides in field tests and Fleet Exercises, including Silent Hammer held off the U.S. West Coast in 2004.

For more information on Naval Postgraduate School research on atmospheric intelligence and the transitioning of operational METOC products to support the War on Terrorism, contact Prof. Davidson at kldavids@nps.edu or (831) 656-2309.